Teaching Plan (GE-2: Discrete Mathematics):

Week 1: Compound Statements (and, or, implication, negation, contrapositive, quantifiers), Truth tables. [2] Chapter 1 (Sections 1.1, and 1.3).
Week 2: Basic logical equivalences and its consequences, Logical arguments, Set theory. [2] Chapter 1 (Sections 1.4, and 1.5), and Chapter 2 (Section 2.1).
Week 3: Operation on sets, types of binary relations, Equivalence relations, Congruences and its properties. [2] Chapter 2 [Sections 2.2, 2.3, and 2.4 (left for convergence)], and Chapter 4 (Section 4.4).
Week 4: Partial and total ordering, Lattices. [2] Chapter 2 (Section 2.5).
Week 5: Properties of integers, Division algorithm, Divisibility. [2] Chapter 4 (Sections 4.1 to 4.1.6).
Week 6: Euclidean algorithm, GCD, LCM, Relatively prime. [2] Chapter 4 (Section 4.2).
Week 7: Prime numbers, statement of fundamental theorem of arithmetic, Fermat primes. [2] Chapter 4 (Sections 4.3 up to 4.3.11, page 119).
Week 8: Mathematical induction, Recursive relations and its solution (characteristics polynomial and generating function). [2] Chapter 5 (Sections5.1, 5.3, and 5.4).
Week 9: Principles of counting (inclusion /exclusion, pigeon-hole), permutation and combinations (with and without repetition). [2] Chapter 6 (Section 6.1), Chapter 7 (Sections 7.1 to 7.3).
Week 10: Duality principle, lattices as ordered sets. [1] Sections 1.20, and 2.1 to 2.7.
Week 11: Lattices as algebraic structures, Sublattices, Products and Homomorphisms, Distributive lattices. [1] Chapter 2 (Sections 2.8 to 2.19), Chapter 4 (Sections 4.1 to 4.11)
Week 12: Boolean algebras, Boolean polynomials, Minimal forms of Boolean polynomials. [3] Chapter 1 (Section 2)
Weeks 13 and 14: Quinn−McCluskey method, Karnaugh diagrams, Switching circuits and applications of switching circuits. [3] Chapter 2 (Section 1).

Semester-III

GE-3: Differential Equations (with Practicals)
OR
GE-3: Linear Programming and Game Theory

GE-3: Differential Equations (with Practicals)

Total Marks: 150 (Theory: 75, Internal Assessment: 25, and Practical: 50)
Workload: 4 Lectures, 4 Practicals (per week) **Credits:** 6 (4+2)
Duration: 14 Weeks (56 Hrs. Theory + 56 Hrs. Practical) **Examination:** 3 Hrs.

Course Objectives: This course includes a variety of methods to solve ordinary and partial differential equations with basic applications to real life problems. It provides a solid foundation to further in mathematics, sciences and engineering through mathematical modeling.
Course Learning Outcomes: This course will enable the students to learn:

i) Analyze real-world scenarios to recognize when ordinary (or systems of) or partial differential equations are appropriate while creating an appropriate model.
ii) Learn explicit methods of solving higher-order linear differential equations.
iii) Solve first and second order partial differential equations using method of characteristics, separation of variables, and reducing to suitable canonical forms.

Unit 1: Ordinary Differential Equations and Applications (Lectures: 20)

First order exact differential equations, Integrating factors and rules to find integrating factors, Linear equations and Bernoulli equations, Orthogonal trajectories and oblique trajectories, Basic theory of higher order linear differential equations, Wronskian and its properties; Solving differential equation by reducing its order.

Unit 2. Explicit Methods of Solving Higher-Order Linear Differential Equations (Lectures: 16)

Linear homogenous equations with constant coefficients, Linear non-homogenous equations, Method of undetermined coefficients, Method of variation of parameters, Cauchy–Euler equations; Simultaneous differential equations.

Unit 3. First and Second Order Partial Differential Equations (Lectures: 20)

Partial differential equations: Basic concepts and definitions. Mathematical problems; First order equations: Classification, Construction, Geometrical interpretation; Method of characteristics, General solutions of first order partial differential equations; Canonical forms and method of separation of variables for first order partial differential equations. Classification of second order partial differential equations. Reduction to canonical forms. Second order partial differential equations with constant coefficients, General solutions.

References:

1. Kreyszig, Erwin. (2011). *Advanced Engineering Mathematics* (10th ed.). Wiley India.
2. Myint-U, Tyn and Debnath, Lokenath (2007). *Linear Partial Differential Equations for Scientist and Engineer*s (4th ed.). Birkkäuser Boston. Indian Reprint.
3. Ross, Shepley. L. (1984). *Differential Equations* (3rd ed.). John Wiley & Sons.

Additional reading:

i. Sneddon I. N. (2006). *Elements of Partial Differential Equations*. Dover Publications.

Practical / Lab work to be performed in a Computer Lab:

Use of Computer Algebra Systems (CAS), for example MATLAB/Mathematica /Maple/Maxima/Scilab etc., for developing the following programs:

1) Solution of first order differential equation.
2) Plotting of second order solution family of differential equation.
3) Plotting of third order solution family of differential equation.
4) Solution of differential equation by variation of parameter method.
5) Solution of system of ordinary differential equations.
6) Solution of Cauchy problem for first order partial differential equations.
7) Plotting the characteristics of the first order partial differential equations.
8) Plot the integral surfaces of first order partial differential equations with initial data.

Teaching Plan (GE-3: Differential Equations):

Weeks 1 and 2: First order ordinary differential equations: Basic concepts and ideas, First order exact differential equation, Integrating factors and rules to find integrating factors. [3] Chapter 1 (Sections 1.1, and 1.2), and Chapter 2 (Sections 2.1, and 2.2). [1] Chapter 1 (Sections 1.1, 1.2, and 1.4).
Week 3: Linear equations and Bernoulli equations, Orthogonal trajectories and oblique trajectories. [3] Chapter 2 (Sections 2.3, and 2.4), and Chapter 3 (Section 3.1).
Weeks 4 and 5: Basic theory of higher order linear differential equations, Wronskian and its properties, Solving a differential equation by reducing its order. [3] Chapter 4 (Section 4.1).
Weeks 6 and 7: Linear homogenous equations with constant coefficients, Linear non-homogenous equations, Method of undetermined coefficients. [3] Chapter 4 (Sections 4.2, and 4.3), and [1] Chapter 2 (Section 2.2).
Weeks 8 and 9: Method of variation of parameters, Cauchy–Euler equations, Simultaneous differential equations. [3] Chapter 4 (Sections 4.4, and 4.5), and Chapter 7 (Sections 7.1, and 7.3)
Week 10: Partial differential equations**:** Basic concepts and definitions, Mathematical problems; First order equationss**:** Classification and construction. [2] Chapter 2 (Sections 2.1 to 2.3).
Weeks 11 and 12: Geometrical interpretation, Method of characteristics, General solutions of first order partial differential equations. [2] Chapter 2 (Sections 2.4, and 2.5).
Week 13: Canonical forms and method of separation of variables for first order partial differential equations. [2] Chapter 2 (Sections 2.6, and 2.7)
Week 14: Second order partial differential equations**:** Classification, Reduction to canonical forms, With constant coefficients, General solutions. [2] Chapter 4 (Sections 4.1 to 4.4).

GE-3: Linear Programming and Game Theory

Total Marks: 100 (Theory: 75 and Internal Assessment: 25)
Workload: 5 Lectures, 1 Tutorial (per week) **Credits:** 6 (5+1)
Duration: 14 Weeks (70 Hrs.) **Examination:** 3 Hrs.

Course Objectives: This course develops the ideas behind the solution of linear programming problem using simplex method, as well as, the solution of transportation and assignment problems. This course also provides an introduction to game theory which makes possible the analysis of the decision making process of two interdependent subjects.
Course Learning Outcomes: This course will enable the students to:

i) Learn about the simplex method used to find optimal solutions of linear optimization problems subject to certain constraints.
ii) Write the dual of a linear programming problem.
iii) Solve the transportation and assignment problems.
iv) Learn about the solution of rectangular games using graphical method and using the solution of a pair of associated prima-dual linear programming problems.

Unit 1. Linear Programming Problem, Simplex Method and Duality (Lectures: 35)
Graphical method of solution, Basic feasible solutions, Linear programming and convexity; Introduction to the simplex method**:** Theory of the simplex method, Optimality and unboundedness; Simplex tableau and